Abstract. Let E be a holomorphic vector bundle. Let θ be a Higgs field, that is a holomorphic section of $\mathrm{End}\,(E) \otimes \Omega_X^{1,0}$ satisfying $\theta^2 = 0$. Let h be a pluriharmonic metric of the Higgs bundle (E, θ). The tuple (E, θ, h) is called a harmonic bundle.

Let X be a complex manifold, and D be a normal crossing divisor of X. In this paper, we study the harmonic bundle (E, θ, h) over $X - D$. We regard D as the singularity of (E, θ, h), and we are particularly interested in the asymptotic behaviour of the harmonic bundle around D. We will see that it is similar to the asymptotic behaviour of complex variation of polarized Hodge structures, when the harmonic bundle is tame and nilpotent with the trivial parabolic structure. For example, we prove constantness of general monodromy weight filtrations, compatibility of the filtrations, norm estimates, and the purity theorem.

For that purpose, we will obtain a limiting mixed twistor structure from a tame nilpotent harmonic bundle with trivial parabolic structure, on a punctured disc. It is a solution of a conjecture of Simpson.